Exploration Capabilities

Mars Oxygen In-Situ Resource Utilization Experiment (MOXIE)

Completed Technology Project (2014 - 2020)

Project Introduction

The Mars Oxygen In-Situ Resource Utilization Experiment (MOXIE) will be the first in-situ resource utilization (ISRU) technology demonstration on Mars. Competitively selected in 2014, MOXIE will fly on the Mars 2020 rover in 2020, to land on Mars in 2021. Sponsored by HEOMD and the Space Technology Mission Directorate (STMD), MOXIE will utilize solid oxide electrolysis to process Mars' CO_2 atmosphere to produce O_2. MOXIE will be a critical first step in long-duration mission architectures that would require use of local resources to reduce risk and control cost. By partnering with Science Mission Directorate on the Mars 2020 mission, human exploration leverages existing investments in the Mars program while advancing a key technology for NASA.

Experiment objectives are to intermittently operate an oxygen production plant on Mars across a range of diurnal conditions during the primary mission year and producing at least 6 grams of O_2 per hour with 99.6% purity. The technology will demonstrate resilience with respect to dust and other environmental challenges and will return performance parameter data that are critical to the design of a full-scale system.

MOXIE consists of a CO_2 acquisition system (a scroll pump) and a solid oxide electrolysis (SOXE) system to process the atmosphere producing O_2. O_2 will be processed on a batch basis as rover resources allow but of sufficient amounts to test system resiliency. By monitoring the production rate, power usage, and other performance characteristics of the system, MOXIE will provide an assessment of the prospects for extension to a full-scale system in support of a human mission.

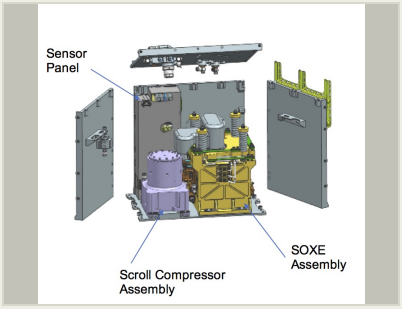
Mars atmosphere enters the system through an inlet valve and dust is filtered out. A scroll pump delivers up to 50 g/hour of atmosphere to the SOXE subsystem. The Mars atmosphere is processed as follows: the SOXE is warmed to 800 C; the pump is started and the filtered air will flow continuously at >1 torr to the SOXE. The O_2 and CO are separated and the flow rate is measured. The O_2 and CO are vented out the side of the rover.

This project was transferred to the STMD Technology Demonstration Missions Program in October 2020.

Anticipated Benefits

A key element of NASA's plans to send humans to Mars is the ability to utilize resources at the destination; this will reduce mass launched from Earth and increase mission resiliency.

Once demonstrated on Mars, incorporation of ISRU technologies in future missions will be key to realizing the vision of a sustainable and resilient space exploration architecture. ISRU is expected to play a key role in NASA's expansion beyond low-Earth orbit. For example, future crewed missions will be



MOXIE Expanded View

Table of Contents

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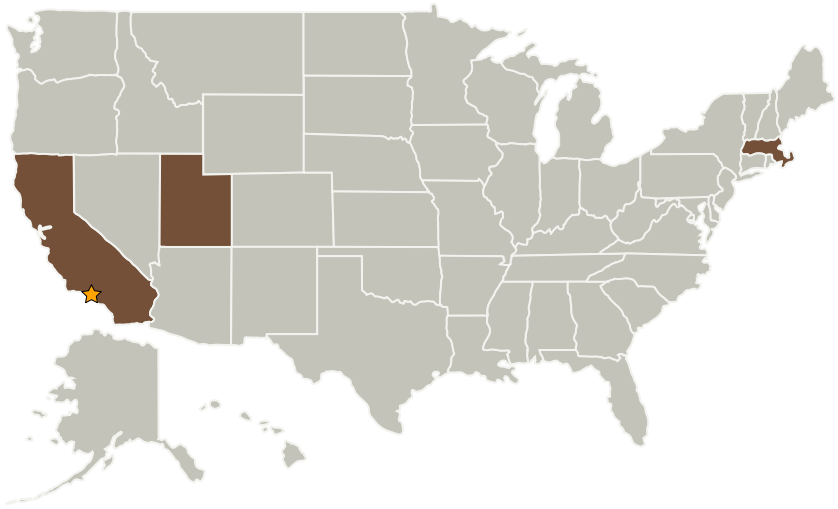
enabled by use of in-situ resources to produce oxygen for propellant and other consumables.

By flight qualifying ISRU, NASA supports the development of a new technology readily available for use by commercial resource prospecting missions. This can create new markets for commercial missions anywhere in the Solar System.

Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Jet Propulsion Laboratory(JPL)	Lead Organization	NASA Center	Pasadena, California
Ceramatec, Inc.	Supporting Organization	Industry	Salt Lake City, Utah
MIT Haystack Observatory	Supporting Organization	Academia	Westford, Massachusetts

Organizational Responsibility

Responsible Mission Directorate:

Exploration Systems Development Mission Directorate (ESDMD)

Lead Center / Facility:

Jet Propulsion Laboratory (JPL)

Responsible Program:

Exploration Capabilities

Project Management

Program Director:

Christopher L Moore

Project Managers:

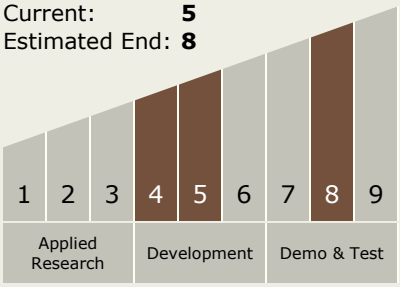
Jeffrey A Mellstrom
Dayna S Ise

Principal Investigator:

Michael H Hecht

Technology Maturity (TRL)

Start: **4**
Current: **5**
Estimated End: **8**



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Primary U.S. Work Locations	
California	Massachusetts
Utah	

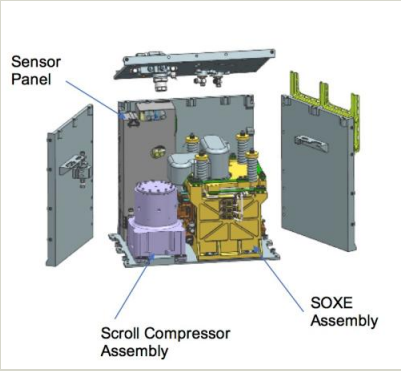
Project Transitions

July 2014: Project Start

September 2020: Closed out

Closeout Summary: STI Curated: 20205007261 https://strives.nasa.gov/submit/20205007222 This AES project was transferred to the NASA Space Technology Mission Directorate (STMD) as of October 2020.

Images



Untitled
MOXIE Expanded View
(https://techport.nasa.gov/image/38020)

Project Website:

https://mars.nasa.gov/mars2020/mission/instruments/moxie/

Technology Areas

Primary:

- TX07 Exploration Destination Systems
  - TX07.1 In-Situ Resource Utilization
    - TX07.1.3 Resource Processing for Production of Mission Consumables

Target Destination

Mars

Supported Mission Type

Planned Mission (Pull)